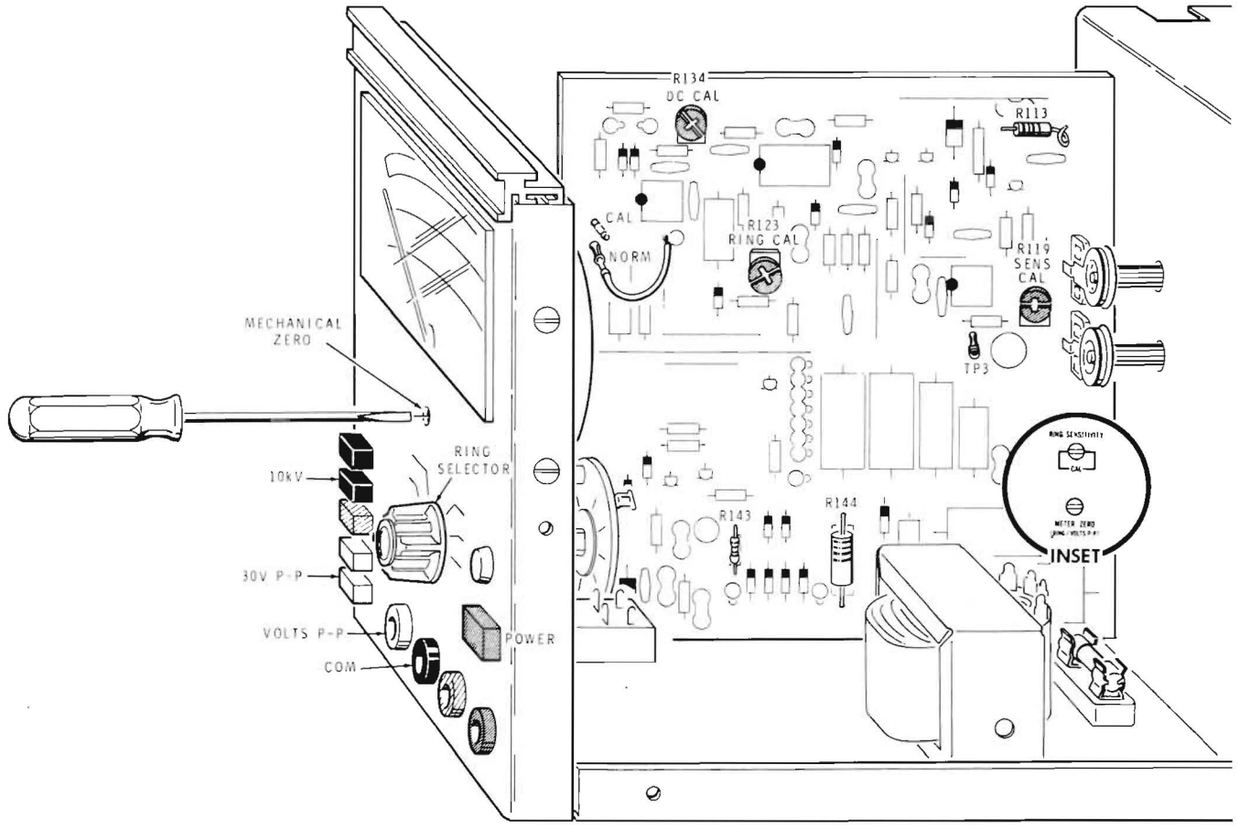
HEATH
ZENITH

Model ST-5235
YOKE/FLYBACK TESTER

595-2278-01

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

TABLE OF CONTENTS


R134
DC CAL
R113
CAL
NORM
R123
RING CAL
R119
SENS
CAL
MECHANICAL
ZERO
TP3
RING
SELECTOR
10kV
30V P-P
VOLTS P-P
COM
POWER
R143
R144
INSET

PICTORIAL 4

SPECIFICATIONS

RING TEST MODE

Coils Tested	Horizontal and vertical windings of yokes, flyback transformers, horizontal linearity and efficiency coils, and general midfrequency (10 KHz to 100 KHz) coils.
Test Method	Applies an exciting pulse to coil under test and detects number of rings which are of preset amplitude or higher.
Preset Ring Amplitude	Set at 25% of initial ring. Adjustable from 10% to 50%.
Ring Scale	Bad reading for less than 9 rings. Good reading for more than 11 rings.
Accuracy	Plus or minus 1 ring at the 10 (mid-scale) point, with Ring Selector switch in its optimum position.

VOLTS P-P MODE

Variable Tested	Drive voltage levels in deflection circuitry.
Voltage Scales	0 to 30 V P-P and 0 to 300 V P-P.
Accuracy	Plus or minus 5% of full scale, from 100 Hz to 200.
Input Impedance	Approximately 1 MΩ in parallel with 75 pF; AC coupled.

HIGH VOLTAGE DC MODE

Variable Tested	CRT high DC voltages.
Method	Optional Heath High Voltage Probe (Model IMA-100-10) is required for high voltage measurement.
Voltage Scales	0 to 10 kV and 0 to 40 kV.
Accuracy	Plus or minus 3% of full scale (including probe).

GENERAL

Power Requirements	Either 120 volts AC, 60 Hz or 240 volts AC, 50 Hz. 5 watts.
Operating Temperature Range	10 to 40°C (50 to 104°F)
Storage Temperature Range	0 to 50°C (32 to 122°F)
Meter	4-1/2" scale, 200 μA moving coil movement.
Dimensions (overall)	5-3/4" wide × 6-7/8" high × 10-3/4" deep (14.6 × 17.4 × 27.3 cm).
Net Weight	6 pounds (2.72 kg).

OPERATION AND APPLICATIONS

Refer to Pictorial 1-1 (Illustration Booklet, Page 1) for the location and function of the Yoke/Flyback Tester controls and connection points.

RING TESTING

WARNING: Before you perform any ring tests, unplug the television set and discharge dangerous capacitor-stored voltages which may remain within the set. Typical areas of potential danger are the second anode, the horizontal output tube, and the high voltage rectifier.

You may use the Tester to check numerous types of coils: horizontal and vertical yoke windings, flyback transformers, horizontal linearity and efficiency coils, and general purpose mid-frequency (10 kHz to 100 kHz) coils. Do not attempt to test ironcore transformers, or other coils that have a Q of 25 or less.

The Yoke/Flyback Tester operates by identifying coils which are "good." If you test a coil using all of the applicable tests (including the out-of-circuit tests and the comparison test), and always receive a BAD indication, the coil is bad. If, however, you receive a GOOD indication for any test, the coil is good.

IN-CIRCUIT TESTING

This test is the easiest to make and faster than having to isolate components. The test includes the entire television horziontal output section, including the horizontal output transformer windings (flyback) and the horizontal and vertical windings of the yoke. A GOOD indication by the meter will mean that the windings are okay and there are no shorts in any of the yoke or flyback windings.

Perform the in-circuit test as follows:

WARNING: Unplug the television set and discharge any capacitor stored voltage within it.

1. Plug in the Tester line cord and depress the red POWER button. The red AC ON lamp should light.

2. Depress the green RING button.

3. Plug the red test lead into the green RING jack and the black test lead into the black COM jack.

4. Remove the plate cap from the horizontal output tube (or, if you are testing a solid-state set, disconnect the collector lead of the horizontal output transistor and one lead of the damper diode).

5. Connect the black COM test lead to the television chassis ground. Then connect the red RING test lead to the plate cap (or to the collector lead of the horizontal output transistor).

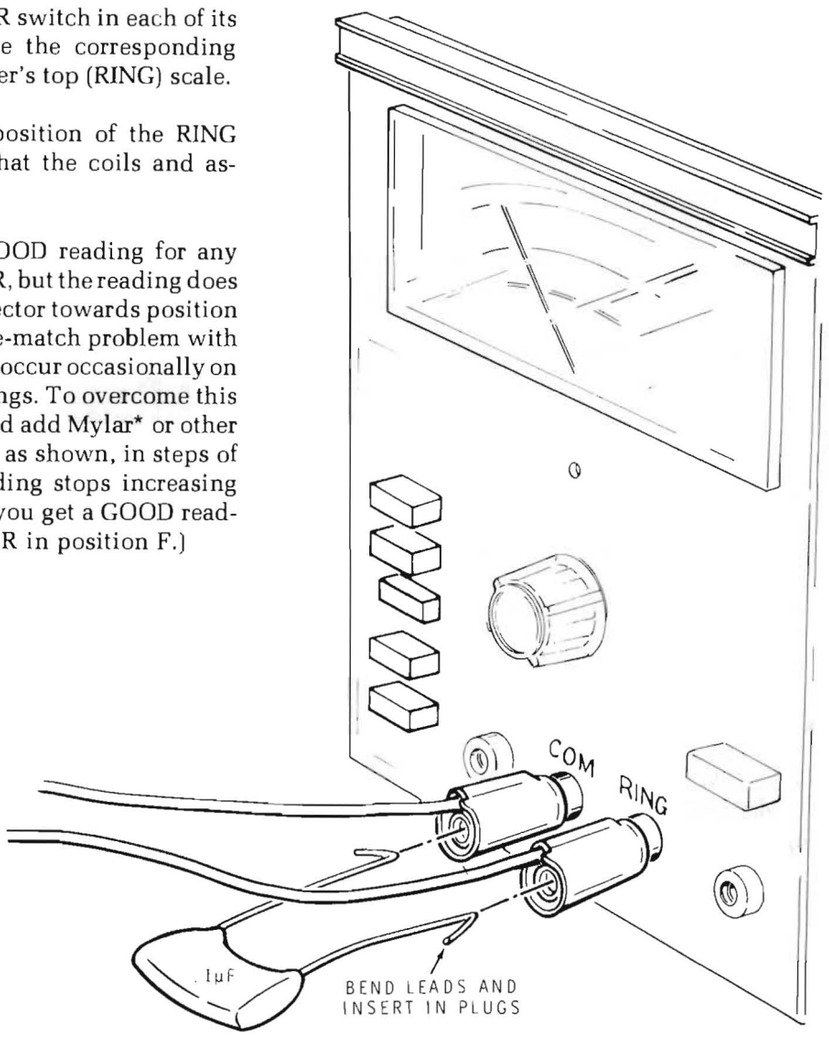
6. Place the RING SELECTOR switch in each of its six positions and observe the corresponding meter reading on the Tester's top (RING) scale.

A GOOD indication for any position of the RING SELECTOR switch indicates that the coils and associated circuitry are good.

NOTE: If you do not get a GOOD reading for any position of the RING SELECTOR, but the reading does increase when you turn the selector towards position F, there might be an impedance-match problem with the winding. This problem may occur occasionally on small or low inductance windings. To overcome this problem, refer to Detail 1-1A and add Mylar* or other low-leakage, high Q capacitors as shown, in steps of about .1uF, until the ring reading stops increasing and starts decreasing, or until you get a GOOD reading (Leave the RING SELECTOR in position F.)

*Registered Trademark, DuPont

If the in-circuit test does not yield a GOOD reading, continue with the out-of-circuit testing procedures which follow. Do not assume that any coil is bad until you have performed all tests.



Detail 1-1A

OUT-OF-CIRCUIT TESTING

If the in-circuit test fails to give the entire circuit a GOOD reading, use the out-of-circuit test to isolate the problem area(s) of the circuitry.

Flyback Test

WARNING: Perform all ringing tests with the television set line cord unplugged and the internal voltages discharged.

Perform the Flyback Test as follows:

1. Disconnect the horizontal yoke coils and remove the high voltage rectifier tube. For solid-state sets, you should have disconnected the damper diode in the in-circuit test.

2. Connect the black COM lead to the chassis ground. Then connect the red RING test lead to the plate cap (or collector of the horizontal output transistor).

3. If the green RING button is not already pressed, press it now.

4. As was done before, place the RING SELECTOR switch in each of its six positions and observe the meter readings.

A GOOD meter reading in any of the RING SELECTOR switch settings indicates that the flyback winding is good and the associated circuitry is free from shorts.

If you do not get a GOOD reading, refer to the NOTE following in the in-circuit test procedure, Page 7. If adding capacitance is not successful, or is not indicated, try to locate the portion of the flyback that is causing the BAD readings. Do this by disconnecting various components or portions of the circuit and retesting the winding after each change.

NOTE: While it is not typical, some coils can test in the doubtful or unacceptable area, even though they are good. Refer to the comparison testing section, for further discussion.

Horizontal Yoke Test

WARNING: Perform all ringing tests with the television set line cord unplugged and the internal voltages discharged.

Test the horizontal yoke as follows:

1. Disconnect the horizontal yoke winding either by unplugging it at the connector (if one is used), or unsoldering at least two of the three wires on the tube-type set or one of the two wires on a solid-state set.

2. Connect the black and red test leads to the yoke at the connector or unsoldered wires. (In a Tube-Type set, one of the three wires will be left unconnected.)

3. If the green RING button is not already pressed, press it now.

4. As was done before, place the RING SELECTOR switch in each of its six positions and observe the meter readings.

5. If you are testing a tube type set, move one of the test leads to the wire than was left unconnected in step 2. Then repeat step 4.

If you do not get a GOOD reading for steps 4 and 5 (if used), refer to the NOTE following the in-circuit test procedure, Page 7. If adding capacitance is not successful or is not indicated, refer to the "Comparison Test," Page 9.

If you do get a GOOD reading, the horizontal yoke is good and the problem is somewhere else. Refer to the vertical yoke testing procedure, which follows.

Vertical Yoke Test

WARNING: Perform all ringing tests with the television set line cord unplugged and the internal voltages discharged.

Proceed as follows to test the vertical yoke without having the results affected by other portions of the television circuitry:

1. Disconnect the vertical yoke winding either by unplugging the connector (if one is used) or unsoldering at least three of the four wires for the vertical winding.

2. Connect the black and red test leads to the wire pair from either vertical winding.

3. As was done before, place the RING SELECTOR switch in each of its six positions and observe the meter reading for each position. If the reading indicates the need for additional capacitance, as discussed in the NOTE following the in-circuit test procedure, Page 7, add capacitance until you get a maximum meter reading.

4. Connect the two test leads to the wire pair from the remaining vertical winding.

5. Repeat the procedure outlined in step 3.

The vertical yoke is good if the two windings give identical GOOD indications under identical RING SELECTOR/ capacitance conditions.

If the two windings give identical BAD readings, they still may be good. Refer to the "Comparison Test".

If the windings give dissimilar readings, the vertical portion of the yoke is bad.

Comparison Test

If you obtain low meter readings in each type of ringing test, including a final test with the coil totally isolated from the rest of the circuit, the coil is probably bad. However, certain coils will occasionally fail to give a GOOD reading even though they are known to be good. One cause of such a response could be an internal damping resistor.

The Yoke/Flyback Tester has the ability to check even these coils, if an identical model that is known to be good is available for recalibration of the meter. Unless you are familiar with the response of the coil type being tested and know that the readings are not what can be expected from that type, use comparison testing as the final check of that coil.

Proceed as follows to perform the comparison test:

1. Connect the test leads to the coil that is known to be good.

2. Set the RING SELECTOR switch to the position that gives the highest reading on the meter. If necessary, add capacitance as described in the NOTE for the in-circuit test procedure.

3. Adjust the RING SENSITIVITY/CAL control on the back of the Tester to the position which gives a reading of 10 on the meter's RING scale.

4. Disconnect the good coil and connect the coil that is to be tested.

5. If the meter reads in the GOOD or the questionable area, the coil is good; if the meter still reads in the BAD area, the coil is bad.

6. Return the RING SENSITIVITY/CAL control to its original position with the slot horizontal. The Tester is now in its normal calibration, ready to test the normally encountered coils.

VOLTAGE MEASUREMENT

PEAK-TO-PEAK-DRIVE VOLTAGE

The Yoke/Flyback Tester provides two voltage ranges for measuring the drive voltages to the horizontal output stage.

WARNING: Always unplug the television set line cord and discharge the capacitor-stored voltages in the set before you perform the following tests.

Proceed as follows to measure peak-to-peak voltage:

1. Turn on the Tester.
2. Plug the red test lead into the white VOLTS P-P jack, and the black test lead into the black COM jack.
3. Depress the white 300V P-P button.
4. Make sure the television set line cord is unplugged and the capacitor-stored voltages inside the set are discharged.
5. Connect the black COM test lead securely to the television chassis. Then connect the red VOLTS P-P test lead to the horizontal output tube grid (on tube-type sets) or the horizontal drive transistor base (on solid-state sets).
6. Plug in the television set line cord and turn on the set.
7. Read the drive voltage on the VOLTS P-P scale. Remember to multiply the reading by ten while the 300V P-P button is depressed. If the voltage is below 30 volts, press the 30V P-P button and read the voltage directly from the scale.
8. Consult the service literature for the set, or the following table, and determine what the typical drive voltage should be for the set you are servicing.
9. Remember to unplug the television line cord and discharge dangerous voltages before you remove the test leads.

Typical Drive Signals

The following are average drive signal values used in most TV sets.

SOLID STATE

Transistor (Common Collector)	90 V P-P
Transistor (Common Emitter)	10 V P-P
SCR	20 V P-P

TUBE TYPE

(Tubes are listed without filament voltages).

TUBE	AVERAGE DRIVE	TUBE	AVERAGE DRIVE	TUBE	AVERAGE DRIVE
—A5	150	—GC6	150	—JM6	180
—AU5	150	—GE5	150	—JN6	160
—AV5	100	—GF5	150	—JR6	180
—BD5	150	—GJ5	120	—JS6	180
—BG6	120	—GJ6	80	—JT6	90
—BQ6	120	—GK6	145	—JU6	100
—CB5	140	—GT5	115	—JV6	150
—CD6	115	—GT7	150	—JY6	100
—CL5	160	—GV5	150	—JZ6	160
—CM5	120	—GW6	125	—KA6	100
—CU6	90	—GY5	110	—KD6	60
—DN6	90	—GY7	95	—KG6	230
—DQ5	190	—HB5	140	—KM6	230
—DQ6	125	—HD5	140	—KN6	160
—E5	70	—HE7	130	—KQ6	160
—EC6	150	—HF5	165	—LB6	210
—EX6	120	—HJ5	150	—LF6	230
—FH6	150	—HK7	1o0	—LQ6	200
—FN6	150	—JB6	160	—LR6	230
—FW5	150	—JE6	190	—MH6	160
—GA7	150	—JF6	125		
—GB5	105	—JG6	100		

HIGH VOLTAGE DC

You may measure high voltage DC with the tester and an optional IMA-100-10 high voltage probe.

WARNING

Always unplug the television line cord and discharge the capacitor-stored voltage to chassis ground before you work inside the set. Do not defeat the line cord grounding plug on the Tester.

The triangle figure next to the HV PROBE jack on the tester is a WARNING reminder. Read and follow the instructions for using the high voltage probe, and making high voltage measurements.

When you use the high voltage probe:

1. Always use a ground (COM) lead and make the ground connection first (before the probe).
2. Attach the ground wire to the set chassis ground securely, and in a protected area, so that the wire will not come loose or be knocked loose.
3. If the ground does come loose, do not touch the ground wire or the Tester! Immediately turn the set off or unplug the line cord. Then discharge any stored voltages within the set. When this is done, you may replace the ground wire; then turn the set back on.

Focus or Regulator Voltage

Proceed as follows to measure focus or regulator voltages:

1. Turn on the Tester.
2. Plug the black test lead into the black COM jack, and the red high voltage probe lead into the red HV PROBE jack. Make sure you read the preceding WARNING pertaining to the use of the high voltage probe.
3. Press the 40 kV button on the Tester.
4. Make sure that the television set line cord is unplugged and the dangerous voltages inside the set have been discharged.
5. Attach the black COM test lead **securely** to a place on the set chassis where it will not be knocked loose.
6. Connect the high voltage probe to the high voltage measurement point (either the CRT anode or the focus voltage source). Then plug in the set's line cord and turn the set on.
7. Read the measured voltage from the meter 40 kV scale.
8. If the voltage is less than 10 kV, press the 10 kV button and read the voltage on the 10 kV scale.
9. Compare the actual voltage with the voltage indicated on the schematic for that set.
10. Remember to unplug the television line cord and discharge dangerous voltages before you remove the test lead or the high voltage probe.

Second Anode Voltage

Proceed as follows to measure the second anode voltage:

1. Turn on the Tester.

2. Plug the black test lead into the black COM jack, and the red high voltage probe and into the red HV PROBE jack. Make sure you read the preceeding WARNING pertaining to the use of the high voltage probe.

3. Press the 40 kV button on the Tester.

4. Make sure that the television set line cord is unplugged and the dangerous voltages inside the set have been discharged.

5. Attach the black COM test lead securely to a place on the set chassis ground where it will not be knocked loose.

6. Connect the high voltage probe to the CRT second anode button. Then plug in the set's line cord and turn the set on.

7. Consult the television manufacturer's literature, if available, to determine any necessary test conditions such as brightness level or channel selector settings, etc.

8. Read the measured voltage from the meter 40 kV scale.

9. Compare the actual voltage with the voltage indicated on the schematic for that set.

10. Remember to unplug the television line cord and discharge dangerous voltages before you remove the test lead or the high voltage probe.

IN CASE OF DIFFICULTY

This section of the Manual will help you locate and correct any difficulty which might occur in your Yoke/Flyback Tester. The information is divided into two sections. The first section, "General," contains suggestions in the following areas:

A. Bench testing and precautions.

B. Repair techniques.

The second section consists of "Troubleshooting Charts." They call out specific problems that may occur and list one or more conditions or components that could cause each difficulty. A "Circuit Board X-Ray View" is provided (on Page 6 in the "Illustration Booklet") to help you locate the components.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover.

GENERAL

BENCH TESTING

WARNING: The full AC line voltage is present at several points in the Tester. Be careful to avoid personal shock when you work on the Tester. Refer to Pictorial 2 (on Page 2 in the "Illustration Booklet").

- Be cautious when you test the transistors and integrated circuits. Although they have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage and current than are other circuit components.
- Be careful that you do not short any terminals to ground when you make voltage measurements. If the probe should slip, for example, and short out a bias or voltage supply point, it may damage one or more components.
- Do not remove any components while the Tester line cord is connected to the AC outlet.
- When you make repairs to the Tester make sure you eliminate the cause as well as the effect of the trouble. If you should find a damaged resistor, be sure you find out what caused the resistor to become damaged. If the cause is not eliminated, the replacement resistor may also become damaged when the Tester is put back into operation.

- Refer to the "Circuit Board X-Ray View" (in the "Illustration Booklet") and to the Schematic diagram to locate the various components.

- Use a high-input impedance voltmeter to make any voltage measurements. Be sure the tester and all test instruments are properly grounded to each other.

REPAIR TECHNIQUES

Components

To remove faulty resistors or capacitors from the circuit board, first clip the component body from its leads on the top of the board; then heat the solder on the foil and allow the lead to fall out of the hole. Preshape the leads of the replacement part and insert them into the holes in the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

Transistors can be removed in the same manner. The replacement transistor must be installed with its leads in the proper holes. Then quickly solder the leads to avoid heat damage. Cut off the excess lead lengths.

CAUTION: On several areas of the circuit board, the foil patterns are quite narrow. When you unsolder a part for checking or replacement, avoid excessive heat when you remove the part. A suction-type desoldering tool will make part removal easier.

Foil Repair

A break in a circuit board foil can be bridged by soldering across the break. Large gaps in the foil should be bridged with a length of bare wire. Lay the wire across the gap and solder each end to the foil.

TROUBLESHOOTING CHARTS

The following charts list specific difficulties that you may encounter in the Yoke/Flyback Tester during calibration or normal operation. Locate the problem area by referring to the titles of the various charts and the "Problem" columns within the charts. The "Possible Cause" column will often list one or more possible causes for a given problem; when investigating these, check the settings of any listed controls before you check any components.

Refer to the circuit board X-Ray view and to the Schematic drawing for help in locating circuit components.

POWER SUPPLY TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE
"AC ON" does not light when the Tester is turned on.	1. Fuse F1. 2. POWER switch SW2. 3. Transformer T1. 4. Lamp PL1.
Voltage at R144 is not 15 volts ± 10%.	1. Diodes D117, D118, D119, D121, or D122. 2. Capacitor C131. 3. Resistor R144. 4. Transformer T1.
Voltage at R143 is not 20 volts ± 10%.	1. Capacitor C129. 2. Diodes D117, D118, D119, or D121. 3. Resistor R143. 4. Transformer T1.
Voltage at R145 is not -15 volts ± 10%.	1. Capacitor C132. 2. Diodes D117, D118, D119, D121, or D123. 3. Resistor R145.

DC CALIBRATION TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE
Rear panel METER ZERO R131 control not effective.	1. Control R131. 2. Front panel switches improperly set. 3. IC U103. 4. Meter M1. 5. Resistors R132 or R133. 6. Control Rl34. 7. Diodes D111 or D112. 8. Transistors Q105 or Q106. 9. Diodes D113 or D114.
Meter deflects to the left.	1. Jumper wire U not on CAL pin.
DC CAL control (R134) not effective.	1. Front panel switches improperly set. 2. Tester Com lead not connected to TP3. 3. Jumper wire U not on CAL pin. 4. Diode D107. 5. Capacitor C123. 6. Resistors R132, R134, or R135. 7. IC U102 or U103. 8. Meter M1.

AC CALIBRATION TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE
Meter does not read in the 13 to 17-volt range.	1. Front panel switches improperly set. 2. Tester Volts P-P lead not connected properly. 3. Jumper wire U not on NORM pin. 4. Capacitor C128. 5. Transistor Q105 or Q106. 6. Diode D101, D113, or D114. 7. Resistor R101, R102, R103, R136 through R142. 8. Capacitor C107 through C112.

RINGING CALIBRATION TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE
No ringing at TP1, for any position of RING SELECTOR SW1.	1. Tester test leads improperly connected. 2. Front panel switches improperly set. 3. RING SELECTOR switch. 4. Diodes D115 or D116. 5. IC U101A or U101B. 6. Transistors Q101 or Q102. 7. Diodes D102 through D105.
Meter reads very low for all positions of RING SELECTOR SW1.	1. Transistor Q104. 2. Capacitor C125. 3. Diode D109. 4. No pulses at TP2 (see below).
No pulses at TP2.	1. Diode D106. 2. Transistor Q103. 3. IC U102. 4. Diode D108. 5. IC U101C. 6. Diode D109.
SENS CAL control R119 not effective.	1. Rear panel Ring Sensitivity control not in CAL position. 2. Capacitor C123. 3. IC U102. 4. Control R119.
RING CAL control R123 not effective.	1. Transistor Q104. 2. Capacitor C125. 3. Resistors R124 through R126. 4. Control R123.

RINGING OPERATION TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE
A coil known to be good does not get a good reading.	1. Tester is not calibrated (see calibration section, Page 21). 2. Coil has added components in the circuit, dampening the oscillation. 3. Coil is close to a metal surface or object, or a looped piece of wire.

VOLTS P-P OPERATION TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE
Meter fails to deflect or gives readings not within accuracy specifications* on 30V P-P or 300 V P-P scale.	1. Resistors R101, R102, or R103. 2. Diode D101. 3. Switches SW104 or SW105. 4. Transistors Q105 or Q106. 5. DC calibration off (see page 22). 6. Leads not properly connected.
Meter fails to deflect, or gives readings not within accuracy specifications* on 300 V P-P scale.	1. Resistors R101, R102, or R103. 2. Diode D101. 3. Switches SW104 or SW105. 4. Transistors Q105 or Q106. 5. DC calibration off (see Page 22). 6. Leads not properly connected.
Accuracy on either scale is not within specifications,* when measuring at frequencies between 1000Hz and 200kHz.	1. Capacitors C107 through C112. 2. Transistors Q106 or Q107.

HIGH VOLTAGE OPERATION TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE
Meter does not deflect, or deflects backwards.	1. Test leads improperly connected. 2. High voltage probe (IMA-100-10). 3. IC U103.
Meter deflects to full scale.	1. Front panel switches improperly set. 2. Resistors R127, R128, or R129. 3. Switches SW101 or SW102. 4. IC U103.
Meter deflects 3/4 of full scale with no input.	1. Jumper wire U not on NORM pin. 2. IC U103.
Accuracy (as compared to industry standard) not within specifications.	1. DC calibration (see Page 22). 2. Resistors R127, R128, or R129. 3. High voltage probe (IMA-100-10). 4. Switches SW101 or SW102. 5. Meter M1.

*When checked with industry standard equipment.

CIRCUIT DESCRIPTION

INTRODUCTION

The circuit description is divided into the categories shown on the block diagram (Illustration Booklet, Page 5). Refer to it and to the schematic (fold-in), which also shows waveforms, as you read.

The circuit description first describes the ring testing mode of operation, discussing each block of the diagram in order. The remainder of the description discusses the circuitry for the other measurement functions, and the 5-section switch used for selecting the mode of operation.

POWER SUPPLY

The Power Supply contains a transformer with a dual primary winding, wired for either 120 VAC or 240 VAC operation. The center-tapped secondary output is full-wave rectified by diodes D117, D118, D119, and D121, and filtered by C129 to produce +20 volts DC; Zener diodes D122 and D123, and capacitors C131 and C132, combine to produce voltages of ±15 volts DC. The secondary output is also rectified by diodes D115 and D116 to produce the line sync pulse that is used for the Ring mode of operation.

LINE SYNC PULSE GENERATOR

The line sync pulses from the Power Supply are shaped by Schmidt triggers U101A and U101B, and capacitors C113, C114, and C115 to create the short pulse needed to energize (ring) the coil being tested. Diode D102 provides a clamp to protect U101B from negative-going pulses. Diode D103 provides a clamp to protect the base of Q101 from excessive negative pulses of more than about −16 volts. Transistors Q101 and Q102 invert and amplify the pulse and provide the needed drive capacity. The output line sync pulse is routed to the coil-impedance matching combination (C101 through C106), the buffer (Q103), and the pulse accumlator discharger (Q104).

Diodes D104 and D105 block loading of the ring pulses from the coil being tested and, with Q101 and Q102, also limit (quantize) the ring amplitude by not allowing TP1 to go below about −17 volts. This clamps the first negative going ring at that value of −17 volts and thereby standardizes the maximum voltage of the first positive ring. This allows the tester to retain calibration despite encountering a wide range of coil characteristics.

IMPEDANCE MATCHING

The pulses from the line sync pulse generator are applied to the coil being tested through the Ring jack. Ring Selector switch SW1 places one of six capacitors (C101 through C106) in parallel with the coil to make a ringing circuit. The resultant ringing signal from the coil is returned to the Tester through the same path. The operator chooses the switch position that produces the highest ring indication on the meter.

BUFFER

The N-channel FET, Q103, provides a high impedance input to avoid loading (damping) the ringing of the coil-impedance matching combination. The output of Q103 goes to the comparator. D106 and R114 combine to protect the gate of Q103 from overvoltage damage.

COMPARATOR

Integrated circuit U102 receives the line sync pulse and the subsequent ringing of the coil. It then compares the amplitude of this input from the buffer with the reference level (determined by setting R119, Sens Cal, and R118, Ring Sensitivity). If the input pulse is greater than the reference, then the output of U102 goes low; if the input pulse is less than the preset value, then U102 does not produce any output (stays high). The width of U102's output pulse varies with the magnitude of the input ring signal.

Zener diode D107 and resistors R118, R119, and R121 provide a variable reference voltage to U102. D107 is also used for meter driver calibration. R116 and C122 provide positive feedback for U102 to improve the output waveform.

PULSE FORMER

Integrated circuit U101C inverts the negative pulse from the comparator and produces an output with a consistent pulse width. Control R123 (Ring Cal) adjusts that pulse width to calibrate the circuit to the meter scale. D108 provides overvoltage protection for U101C's input.

PULSE ACCUMULATOR/DISCHARGER

Pulses from the pulse former charge capacitor C125. Diode D109 prevents the charge from leaking off until the end of each line sync measurement cycle. At that time, the line sync pulse from the line sync pulse generator turns Q104 on, discharging C125 in preparation for the next line sync measurement cycle. Thus, the peak charge voltage on C125 is only related to the number of ring cycle pulses that reach C125 during each measurement cycle.

PEAK DETECTOR

The N-channel FET, Q106, provides high input impedance to avoid loading of the pulse accumulator/discharger in the Ring mode of operation. D114 provides overvoltage protection for the gate of Q106. Q105 acts as a follower to Q106, and supplies the drive current to charge C128, which holds the peak voltage for the meter driver. The peak detector is used for both the Ring and the Volts P-P modes of operation.

METER DRIVER

Integrated circuit U103 acts as a voltage-to-current converter and provides the meter drive current from either the peak detector (in the Ring or Volts P-P mode) or the DC divider (in the HV Probe mode). Voltages at the meter are normally very small, but diodes D111 and D112 are provided there to prevent meter damage during overvoltage conditions. In the Ring and Volts P-P modes, R131 (Meter Zero) is used to correct the voltage offset created by diode D113 in the peak detector. Zener diode D107 (see comparator) provides a standard voltage for calibration procedure; R134 (DC Cal) adjusts the meter to this voltage, to provide full-scale meter calibration.

AC CLAMP

The AC clamp circuit is used only in the Volts P-P mode. The combination of D101 and C107 shift the input voltage to provide a positive peak voltage that is equal to the peak-to-peak voltage.

AC DIVIDER

Precision resistors R101, R102, and R103 form a voltage divider to reduce the input voltage and provide either of two output voltages to the peak detector to give the user the choice of full-scale meter deflection from either 300 or 30 volts P-P at the Volts P-P input jack. At higher frequencies (above 2000 Hz), capacitors C108, C109, C111, and C112 modify the divider characteristics to provide a flat frequency response for the Tester over the frequency specified.

DC DIVIDER

The voltage divider, comprised of precision resistors R127, R128, and R129, and the optional High Voltage Probe accessory (IMA-100-10) reduce the input voltage and provide either of two output voltages to the meter driver which will produce full-scale meter deflection for probe input voltages of either 10 kV or 40 kV, as selected by the user.

MODE SWITCHING

A 5-switch assembly (SW101 through SW105) is used to select the mode of operation. Only one of the five switches (SW101 through SW105) should be depressed at one time.

Refer to the schematic diagram for the switch wiring. The following description indicates what connections are made when each pushbutton is pressed.

Depressing SW101 (HV Probe, 40 kV) connects the DC Divider to the meter driver input through SW101A, and includes R135 in the DC calibration circuitry through SW101B.

Depressing SW102 (HV Probe, 10 kV) connects the DC divider to the meter driver input through SW102B, and includes R135 in the DC calibration circuitry through SW102A.

Depressing SW103 (Ring) connects the Ring jack to the pulse generator through SW103A, and connects the pulse accumulator Discharger to the peak detector input through SW103B.

Depressing SW104 (Volts P-P, 300V) connects the AC divider to the peak detector input through SW104B. SW104A is not used.

Depressing SW105 (Volts P-P, 30 V) connects the AC divider to the peak detector input through SW105A. SW105B is not used.

CALIBRATION

INTRODUCTION

The following procedures are not required as part of the normal operation sequence for the Tester; normal "calibration" consists of returning the rear panel RING SENSITIVITY-CAL control to its normal (horizontal) position after "Comparative Testing" of an abnormal coil. However, you should use the entire following sequence as part of the initial test procedure, and periodically in the future to check the Tester's operation.

The most convenient way to gain access to the circuit board for calibration is to remove the top and side plates as a single assembly. Refer to Pictorial 3 (Illustration Booklet, Page 2) and remove the four screws marked A, B, C, and D from each side of the tester. Removal will be easier if you also loosen screws E and F slightly. Then slide the top side assembly back and up to remove it. Reserve this procedure to replace the top side assembly.

Refer to Pictorial 4 (Illustration Booklet, Page 3) for the following steps.

( ) With the Tester unplugged, insert a small screwdriver through the hole in the front panel just below the meter, and adjust the meter needle (if necessary) to give a reading of zero.

( ) Set the three circuit board control potentiometers to their mid positions:

SENS CAL	R119
RING CAL	R123
DC CAL	R134

( ) Set the two rear panel controls at midposition (exactly horizontal) as shown in the inset drawing.

( ) Make sure the gray jumper wire on the circuit board is connected to the NORM pin.

Proceed to the "DC Voltage Calibration."

DC VOLTAGE CALIBRATION

1. ( ) Plug in the line cord and press the red POWER button to turn the Tester on.

2. ( ) Plug the black test lead into the black COM banana jack on the front panel. Then attach the black alligator clip to TP3 on the circuit board.

3. ( ) Press the white 30V P-P button.

4. ( ) Adjust the METER ZERO control on the back panel to give a zero reading on the meter.

5. ( ) Press the red 10kV button.

6. ( ) Move the gray jumper wire from the NORM pin to the CAL pin.

7. ( ) Adjust the DC CAL control (R134) on the circuit board to get a meter reading (on the 10 kV scale without the added 000) that is equal to the value given on the "DC CAL Voltage" label.

8. ( ) Return the gray jumper wire to the NORM pin.

( ) Repeat steps 3 through 8.

This completes DC Calibration. Remove the black test lead and proceed to "AC Voltage Calibration."

AC VOLTAGE CALIBRATION

The AC (VOLTS P-P) calibration depends on how accurately the DC voltage is calibrated, and on fixed-value components within the Tester. Perform the following steps to verify proper operation. Refer to "In Case of Difficulty" if the proper results are not obtained.

( ) With the Tester off, press the white 30V P-P button.

( ) Plug the red test lead into the white VOLTS P-P banana jack on the front panel. Then connect the red alligator clip to either the bottom of resistor R143 or the bottom of resistor R144, as shown in the Pictorial.

( ) Turn the Tester on.

( ) The meter should read between 13 and 17 on the 30 VOLTS P-P scale.

( ) Turn the Tester off and remove the red alligator clip from the resistor.

RING CALIBRATION

Refer to Pictorial 5 (Illustration Booklet, Page 4) for the following steps. You will need an oscilloscope with a 10 MΩ low capacitance probe, a yoke that is known to be good, and a 5 MΩ control (prepared as shown in Detail 5C).

( ) Turn the Tester on.

( ) Make sure the RING SENSITIVITY control on the rear panel is set to the CAL position.

( ) Plug the black test lead into the black COM jack and the red test lead into the green RING jack.

( ) Connect the test lead to the yoke.

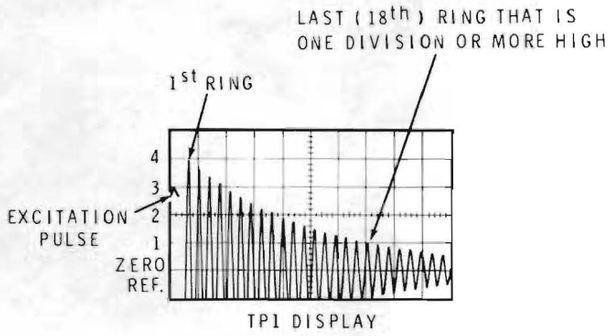
( ) Press the green RING button on the tester.

( ) Connect the oscilloscope common lead to the **circuit board** ground (not the **chassis** ground). One convenient ground point is the loop in the lead of R113, at the top rear of the circuit board.

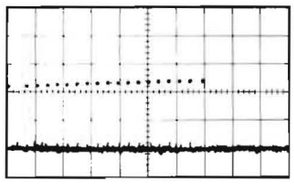
( ) Connect the oscilloscope probe to TP1 on the circuit board.

( ) Rotate the RING SELECTOR switch on the front of the tester to the position that gives the highest meter reading on the ring scale.

( ) Refer to Detail 5A and adjust the oscilloscope controls so that the highest (first) **ring** measures four divisions on the screen. Note that the excitation pulse may show on the screen; do not confuse it with the first ring.



Detail 5A



TP2 DISPLAY

Detail 5B

( ) Count the number of **rings** that are one division or more in height. (The example in Detail 5A has 18 such rings).

( ) Move the oscilloscope probe to TP2 on the circuit board. You should obtain a pattern similar to the one shown in Detail 5B.

( ) Adjust the SENS CAL control, R119, on the Tester circuit board so that the number of pulses on the screen is equal to the number of rings counted in the previous step, plus one (the extra one is the excitation pulse).

( ) Refer to Detail 5C and bend the leads of the 5 MΩ control as shown. Then insert the control leads in the test lead plugs. Turn the control fully clockwise to the maximum resistance position.

( ) Turn the control slowly counterclockwise until the oscilloscope shows only 11 pulses (the excitation pulse plus ten rings).

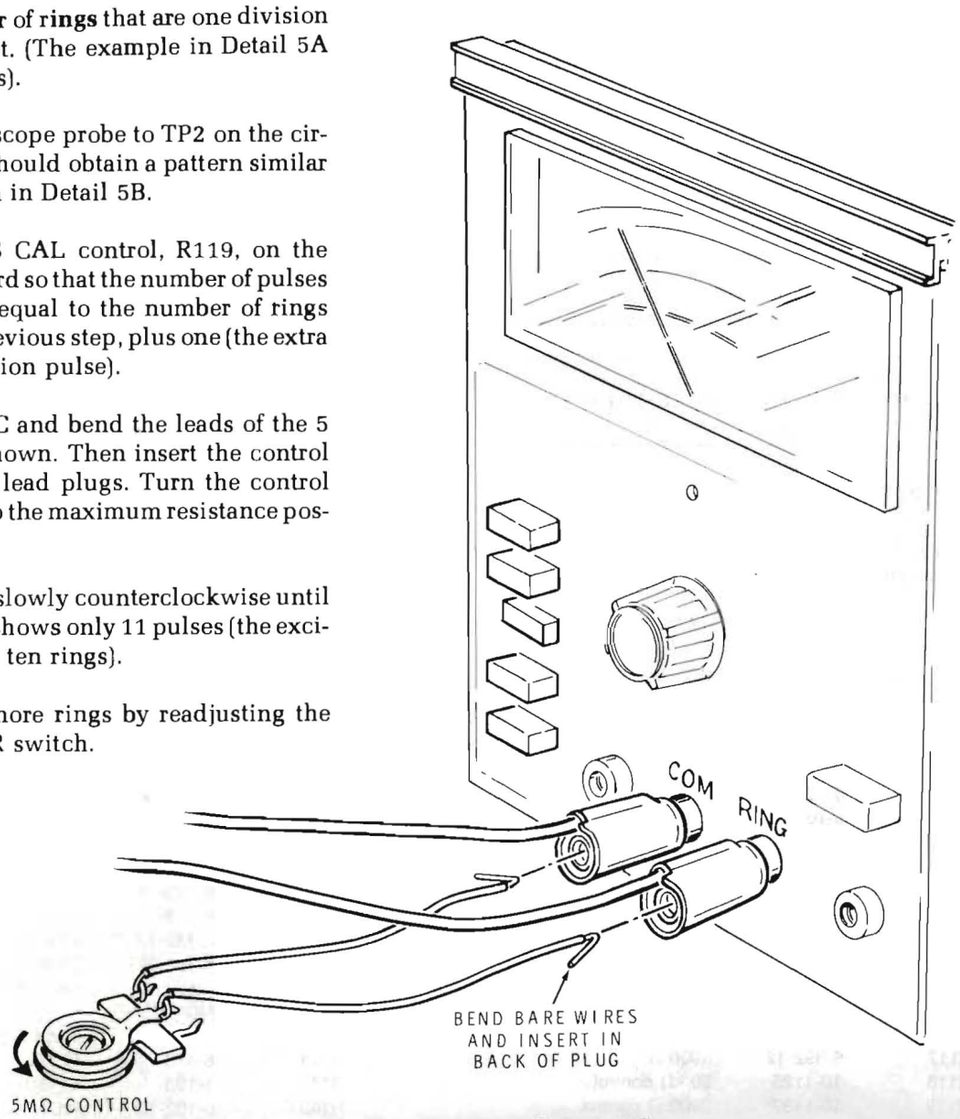
( ) Attempt to get more rings by readjusting the RING SELECTOR switch.

( ) If you did increase the number of pulses, readjust the 5 MΩ control again until only 11 pulses show.

( ) Repeat the two previous steps until changing the RING SELECTOR switch no longer increases the meter reading.

( ) Adjust the RING CAL control, R123 on the circuit board, to give a meter reading of 10 rings.

This completes the calibration of the Yoke/Flyback Tester.



Detail 5C

APPENDIX

This section includes a "Parts List" of all components necessary for instrument maintenance. The "Circuit Board X-Ray View" is in the Illustration Booklet, Page 6.

PARTS LIST

Component values and circuit component numbers refer to the Schematic, X-Ray View, and any related Figures. Where there is a component variation between models, it is noted in the description.

RESISTORS

NOTE: Resistors are 1/4-watt, 5% tolerance unless noted otherwise.

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
R1	6-275	2.7 MΩ, 1/2-watt
R2	6-473	47 kΩ, 1/2-watt
R101	6-6493	649 kΩ, 1%, 1/2-watt
R102	6-3163-12	316 kΩ, 1%
R103	6-3482-12	348 kΩ, 1%
R104	6-104-12	100 kΩ
R105	6-824-12	820 kΩ
R106	6-123-12	12 kΩ
R107	6-104-12	100 kΩ
R108	6-392-12	3900 Ω
R109	6-392-12	3900 Ω
R110	NOT USED	
R111	6-102-12	1000 Ω
R112	6-104-12	100 kΩ
R113	1-166	10 MΩ, 1/2-watt
R114	6-124	120 kΩ, 1/2-watt
R115	6-123-12	12 kΩ
R116	6-392-12	3900 Ω
R117	6-392-12	3900 Ω
R118	10-1125	50 kΩ control
R119	10-1137	2000 Ω control
R120	NOT USED	

Resistors (cont'd.)

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
R121	6-152-12	1500 Ω
R122	6-392-12	3900 Ω
R123	10-1138	10 kΩ control
R124	6-272-12	2700 Ω
R125	6-622-12	6200 Ω
R126	6-123-12	12 kΩ
R127	2-52	9 MΩ, 1%, 1/2-watt
R128	6-7503-12	750 kΩ, %
R129	6-2503-12	250 kΩ, 1%
R130	NOT USED	
R131	10-1125	50 kΩ control
R132	6-2803-12	280 kΩ, %
R133	6-5762-12	57.6 kΩ, %
R134	10-1138	10 kΩ control
R135	6-123-12	12 kΩ
R136	6-104-12	100 kΩ
R137	6-152-12	1500 Ω
R138	6-392-12	3900 Ω
R139	6-622-12	6200 Ω
R140	NOT USED	
	10-989	5 MΩ calibration potentiometer
R141	6-473	47 kΩ, 1/2-watt
R142	1-195	43 MΩ, 1/2-watt
R143	6-102-12	1000 Ω
R144	6-221-1	220 Ω, 5%, 1-watt
R145	6-221-1	200 Ω, 5%, 1-watt

HEATHKIT®

CAPACITORS

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
C1	21-71	.005 μF ceramic
C101	20-101	47 pF mica
C102	20-707	470 pF mica
C103	29-59	2200 pF polystyrene
C104	29-60	.01 μF polystyrene
C105	29-61	.033 μF polycarbonate
C106	29-62	.15 μF polycarbonate
C107	27-28	.1 μF Mylar*
C108	20-190	51 pF mica
C109	21-149	2.7 pF ceramic
C110	NOT USED	
C111	20-102	100 pF mica
C112	20-172	1000 pF mica
C113	20-707	470 pF mica
C114	21-176	.01 μF ceramic
C115	20-101	47 pF mica
C116	21-176	.01 μF ceramic
C117	20-101	47 pF mica
C118	20-176	.01 μF ceramic
C119	21-176	.01 μF ceramic
C120	NOT USED	
C121	21-176	.01 μF ceramic
C122	20-101	47 pF mica
C123	25-917	10 μF electrolytic
C124	20-707	470 pF mica
C125	29-59	2000 pF polystyrene
C126	21-176	.01 μF ceramic
C127	21-176	.01 μF ceramic
C128	25-917	10 μF electrolytic
C129	25-917	10 μF electrolytic
C130	NOT USED	
C131	25-875	1000 μF electrolytic
C132	25-872	220 μF electrolytic
C133	21-176	.01 μF ceramic

SWITCHES

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
SW1	1351	Rotary switch
SW2	64-799	DPST pushbutton
SW101 through SW105	64-874	5-section pushbutton

SEMICONDUCTORS

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
D101	57-64	DRS-110 diode
D102	56-56	1N4149 diode
D103	56-56	1N4149 diode
D104	56-56	1N4149 diode
D105	57-64	DRS-110 diode
D106	56-56	1N4149 diode
D107	100-1766	Calibration diode
D108	56-56	1N4149 diode
D109	56-56	1N4149 diode
D110	NOT USED	
D111	56-56	1N4149 diode
D112	56-56	1N4149 diode
D113	56-56	1N4149 diode
D114	56-56	1N4149 diode
D115	56-93	FD333 diode
D116	56-93	FD333 diode
D117	57-65	1N4002 diode
D118	57-65	1N4002 diode
D119	57-65	1N4002 diode
D120	NOT USED	
D121	57-65	1N4002 diode
D122	56-620	15 volt zener diode
D123	56-620	15 volt zener diode
Q101	417-864	MPS-A05 transistor
Q102	417-864	MPS-A05 transistor
Q103	417-884	SF55048 transistor
Q104	417-864	MPS-A05 transistor
Q105	417-865	MPS-A55 transistor
Q106	417-884	SF55048 transistor
U101	443-778	MC14093 integrated circuit
U102	442-75	LM311N integrated circuit
U103	442-670	LF356N integrated circuit

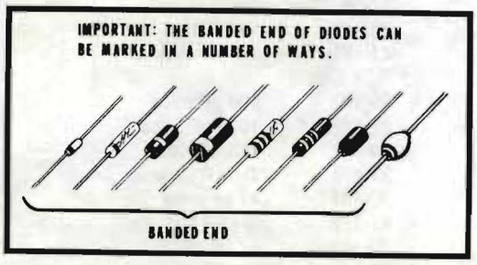
MISCELLANEOUS PARTS

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
M1	407-755	Meter
T1	54-926	Transformer
PL1	412-755	Neon bulb
F1	421-26	3AG, 1/8-ampere, slow-blow fuse

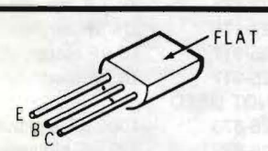
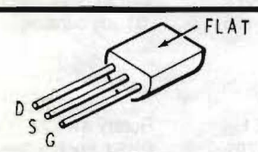
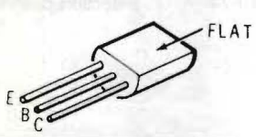
*Registered Trademark, Du Pont

SEMICONDUCTOR IDENTIFICATION CHARTS

DIODES

COMPONENT	HEATH PART NO.	MANUFACTURER'S NUMBER	IDENTIFICATION
D101, D105	57-64	DRS-110	
D102, D103, D104, D106, D108, D109, D111 through D114	56-56	1N4149	
D107	100-1766	IT5235*	
D115, D116	56-93	FD333	
D117, D118, D119, D121	57-65	1N4002	
D122, D123	56-620	15 VOLT ZENER DIODE	

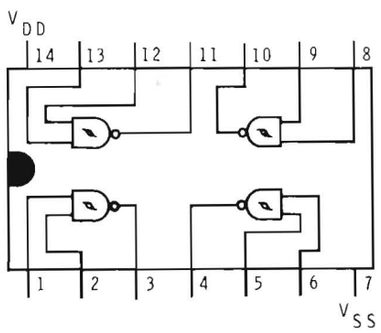
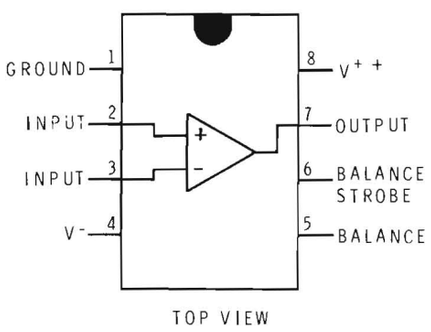
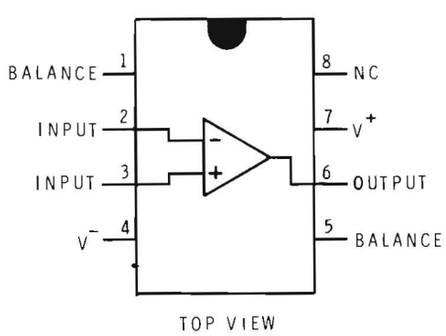
TRANSISTORS

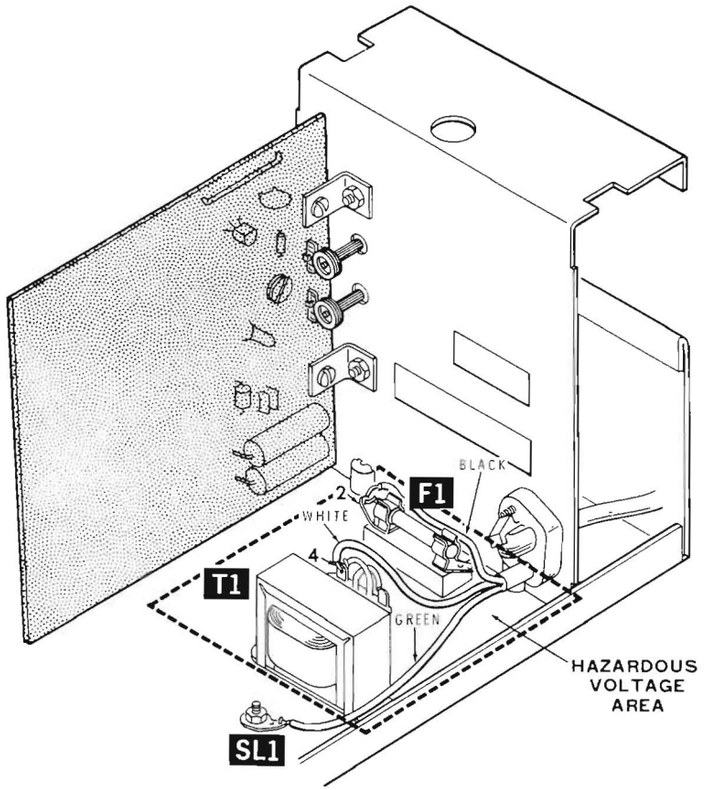
COMPONENT	HEATH PART NO.	MANUFACTURER'S NUMBER	IDENTIFICATION
Q101, Q102, Q104	417-864	MPSA05	
Q103, Q106	417-884	SF55048	
Q105	417-865	MPSA55	

*Specially prepared and measured for calibration purposes.

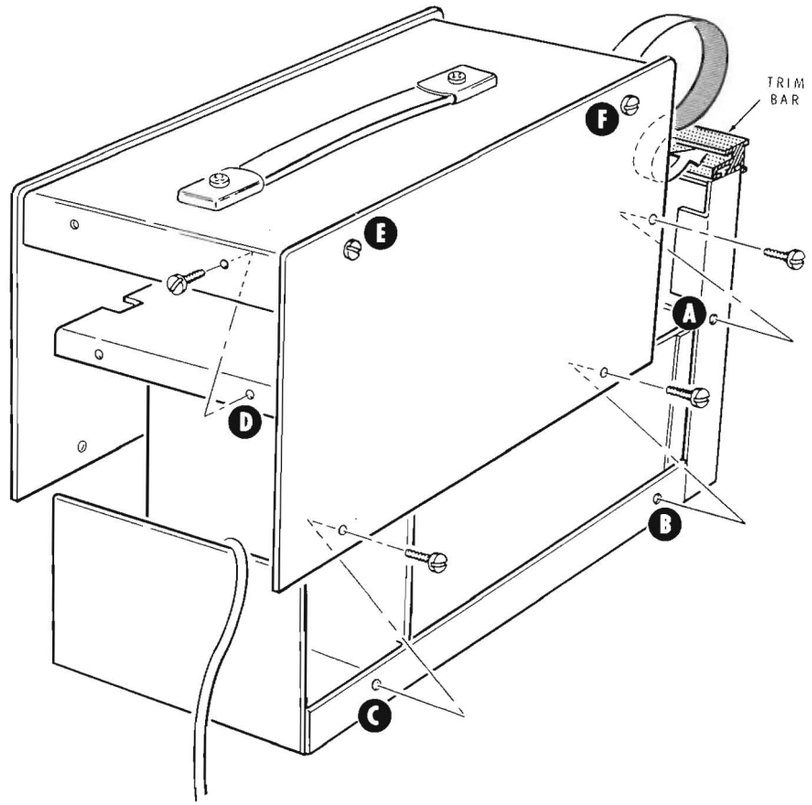
HEATHKIT®

INTEGRATED CIRCUITS

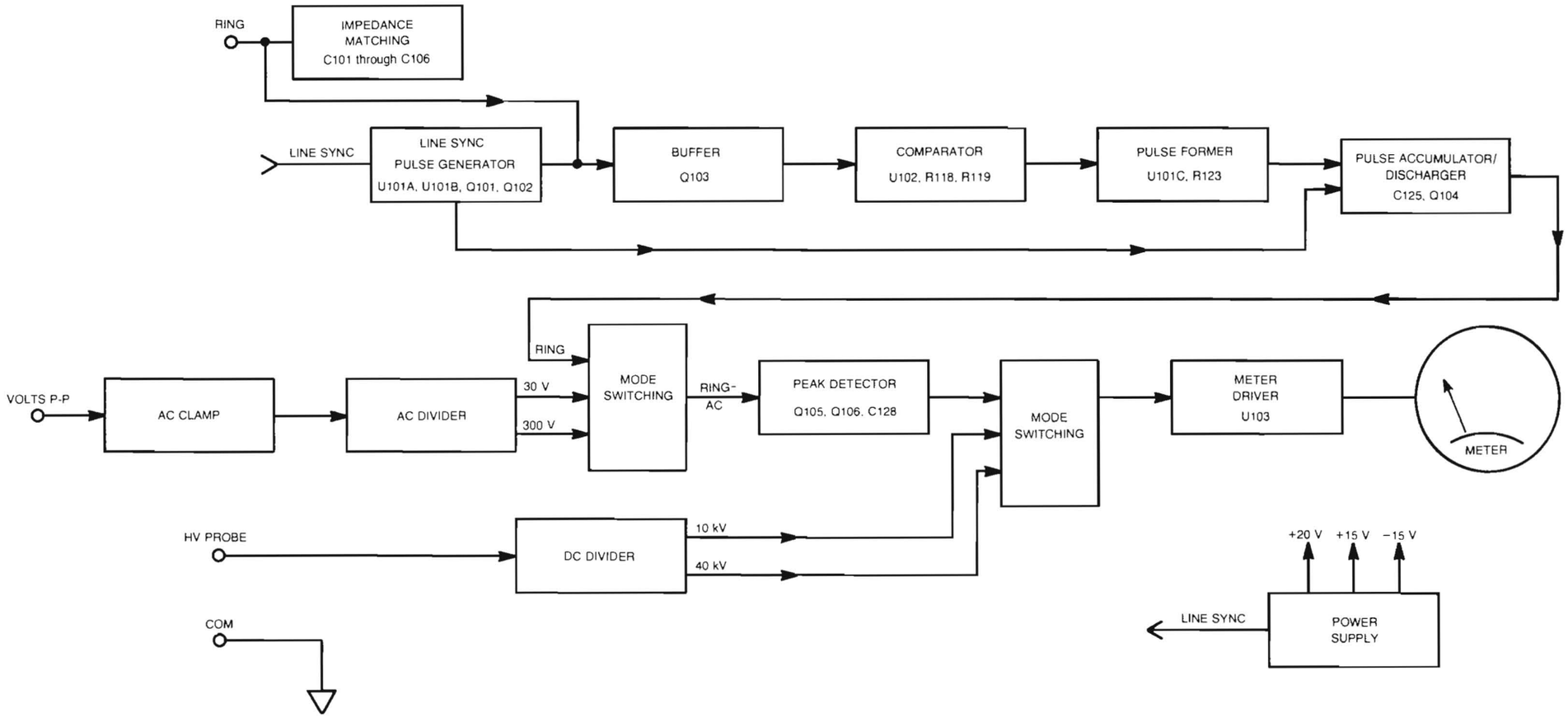
COMPONENT	HEATH PART NO.	MANUFACTORER'S NUMBER	IDENTIFICATION
U101	443-778	MC14093	
U102	442-75	LM 311N	 TOP VIEW
U103	442-670	LF 356N	 TOP VIEW



PICTORIAL 2



PICTORIAL 3



BLOCK DIAGRAM

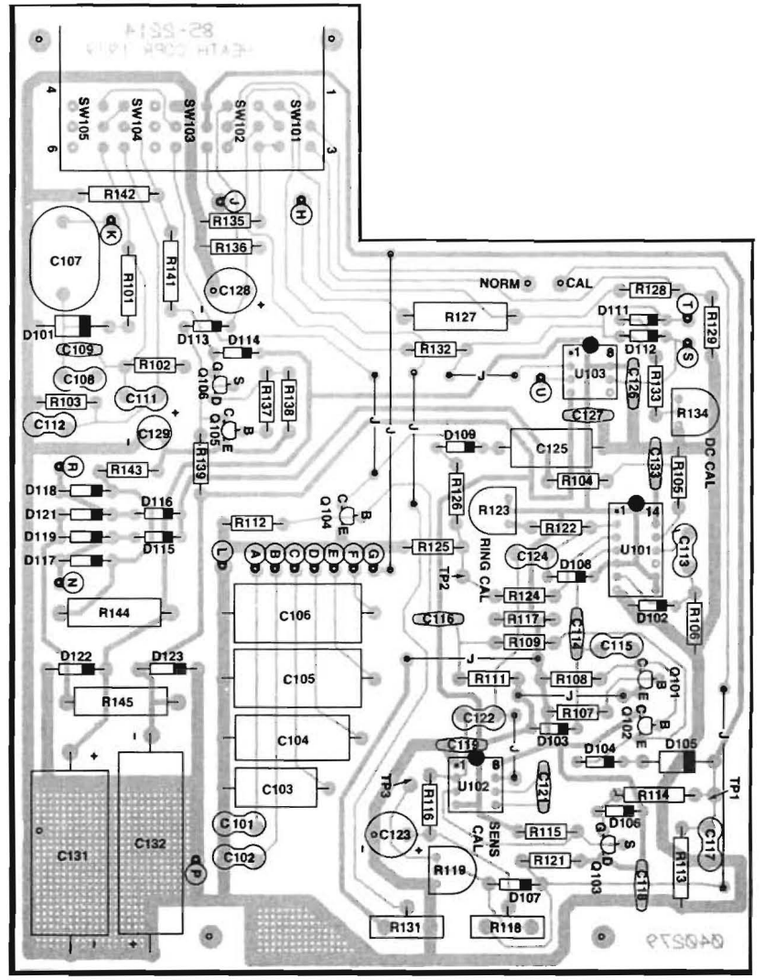
CIRCUIT BOARD X-RAY VIEW

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

A. Find the circuit component number (R5, C3, etc.) on the "X-Ray View."

B. Locate this same number in the "Circuit Component Number" column of the "Parts List."

C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.

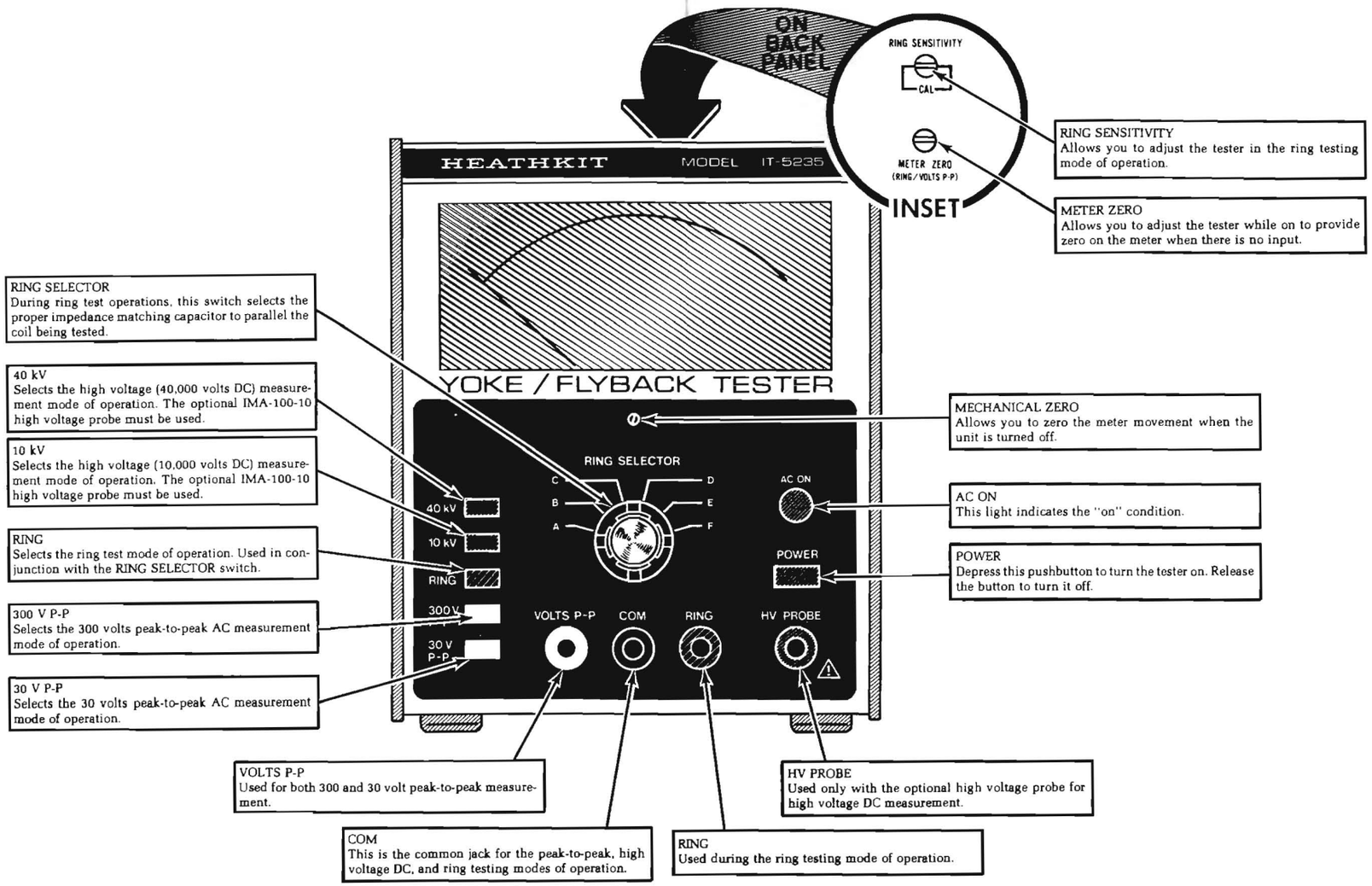


X-RAY VIEW

Shown from Component Side

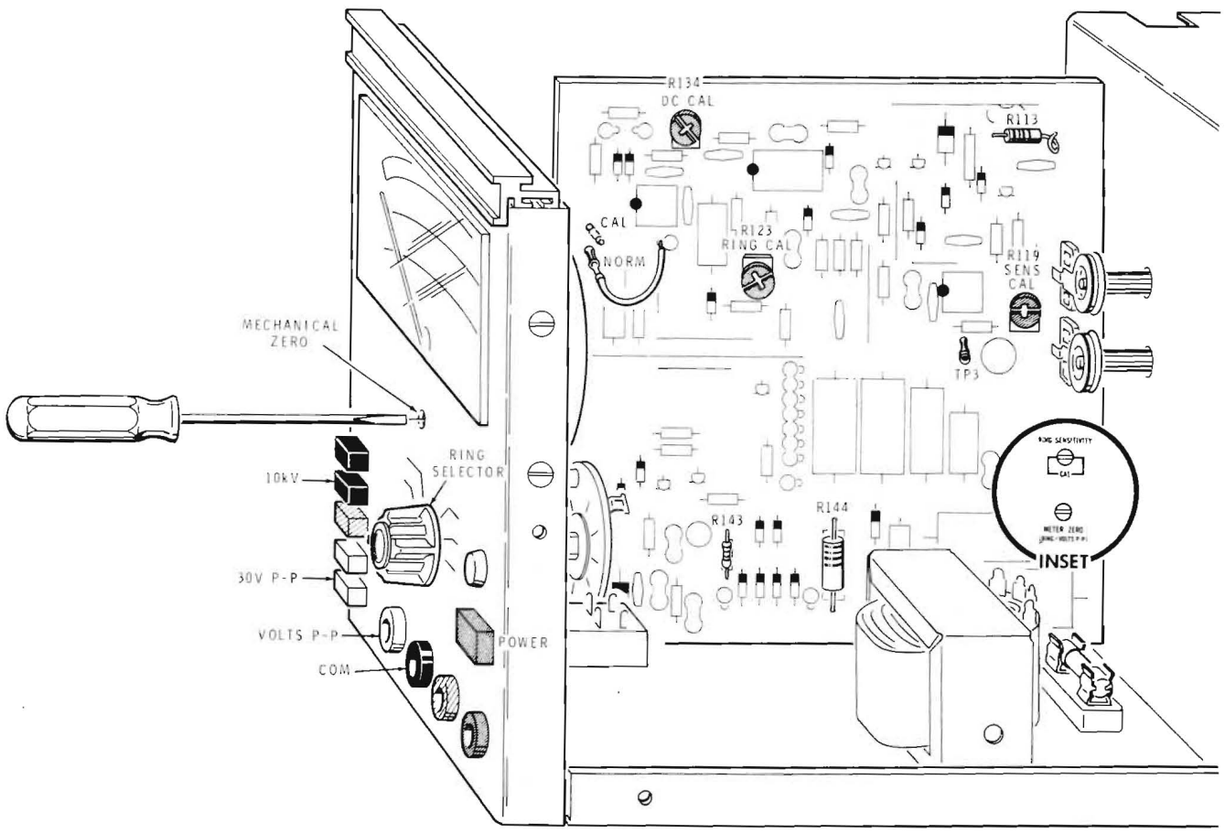
ILLUSTRATION BOOKLET

Part of 595-2278-01

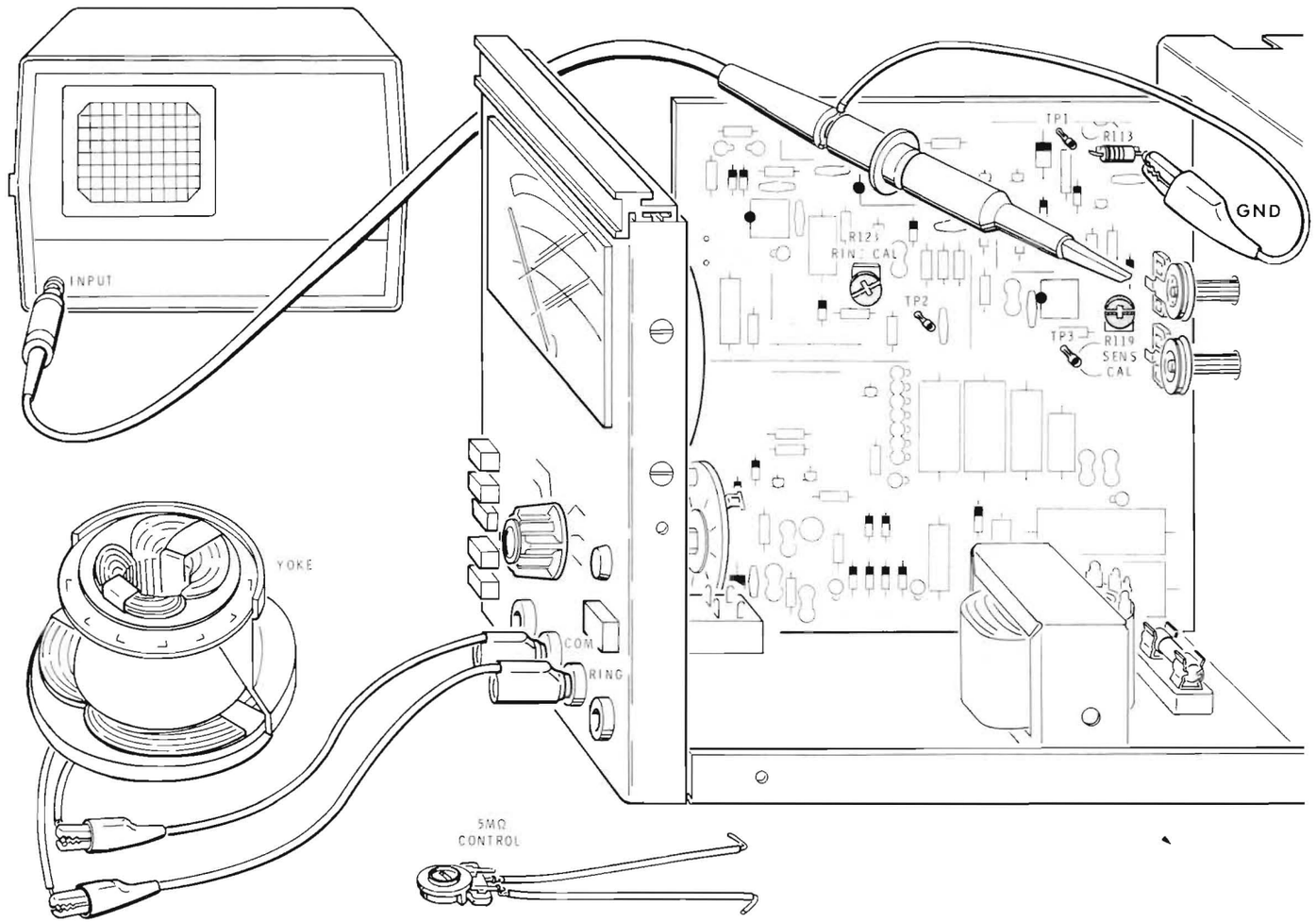


PICTORIAL 1

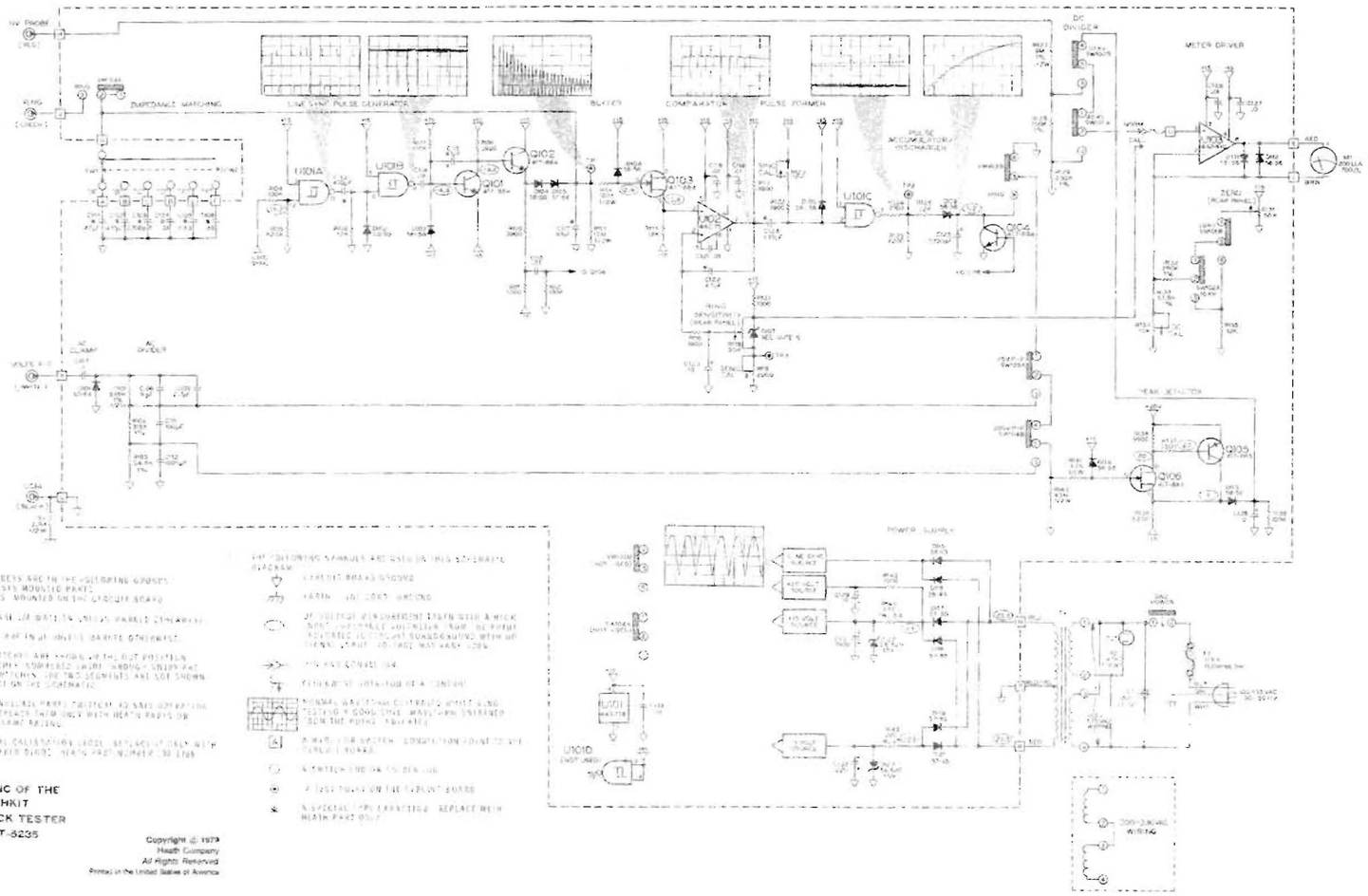
Model ST-5235


R134
DC CAL
R113
CAL
NORM
R123
RING CAL
R119
SENS
CAL
TP3
MECHANICAL
ZERO
RING
SELECTOR
10kV
30V P-P
VOLTS P-P
COM
POWER
R143
R144
INSET

PICTORIAL 4


INPUT
YOKE
COM
RING
5MΩ
CONTROL
TP1
R113
GND
R121
RIN CAL
TP2
TP3
R119
SENS
CAL

PICTORIAL 5



SCHEMATIC OF THE
HEATHKIT
YOKE/FLYBACK TESTER
MODEL ST-5235

Part of 595-2278-01